CLIMATIC PHENOMENA.

By E. N. Munns.

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In studying the distribution of general vegetation, ecologists generally are interested in the climatic factors, as these are a matter of simple and general record, and widespread observations of them have been made for many years throughout the country. Many of these records obtained by the Weather Bureau extend over such a period of years and are so thoroughly reliable that one is warranted in using them as a basis for conclusions as to the distribution of plants.

The principal climatic factors which have to do with the occurrence of types of vegetation are precipitation and temperature for, with a sudden change in either element the types change markedly. Generally speaking, ecologists are concerned with the length of the growing season, precipitation during the growing season, and maximum and minimum temperatures.

The length of the growing season is of importance because it decides whether a given species will be able to ripen and mature its fruits upon which its ability to reproduce depends. Upon the precipitation available during the growing season depends the rate of growth and the ability of the plant to survive long enough to mature fruit. Maximum and minimum temperatures also become limiting factors when the temperatures become excessively high or excessively low. The former is important when it induces wilting because of too rapid transpiration, and the latter when it interferes with growth as in the case of frost damage.

In order to arrange the Weather Bureau data for comparative analysis, it has been found convenient to develop a chart which combines simplicity with use. The construction of this chart is shown graphically in Figure 1, being a series of concentric circles, which are used in this case to indicate the precipitation in amounts of 0.50 of an inch. In order to represent the months, 12 radii are drawn in, equally spaced, and the months arranged clockwise. The precipitation is then plotted by months out from the center on these radii and then connected together, forming an irregular, 12-sided polygon.

As is shown in the right-hand chart in Figure 1, the temperature chart is made up in a similar fashion, using each circle as a 5° interval, and with 20° as the center. On this series of circles the temperature is plotted, forming a second irregular-shaped polygon. When temperatures are below 20°, it is necessary to plot the points below the center, rather than above it, in order to complete the figure. As the growing season begins and ends at about 40°, and the best plant growth is made at a temperature of about 60°, the two circles representing those temperatures are made slightly heavier to make them stand out more prominently as an aid in reading the chart. The points where the perimeter of the temperature polygon crosses the 40° line are assumed to be the beginning and end of the growing season. By drawing a line out from the center to cross the intersection of these lines, the growing season is separated from the dormant period. By plotting this point on the first circle the precipitation is then divided into that occurring in the two seasons; that falling during the dormant period then can be set off from the rest by crosshatching the latter.

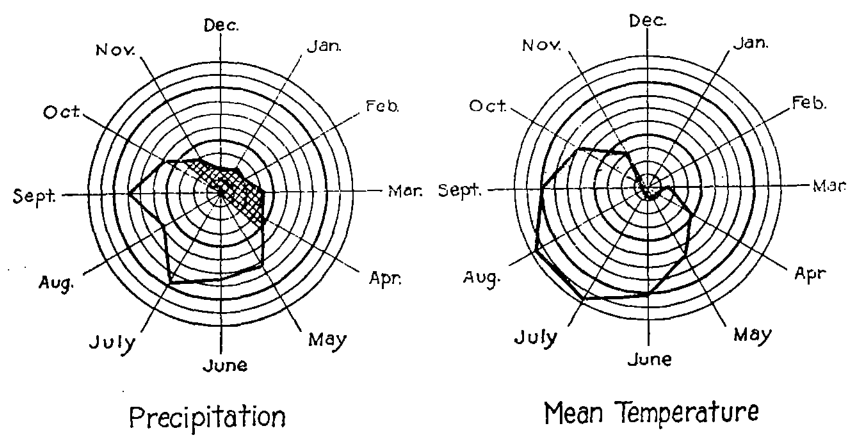

Fig. 1 Climatograph for Menominee, Mich.
Eastern White Pine

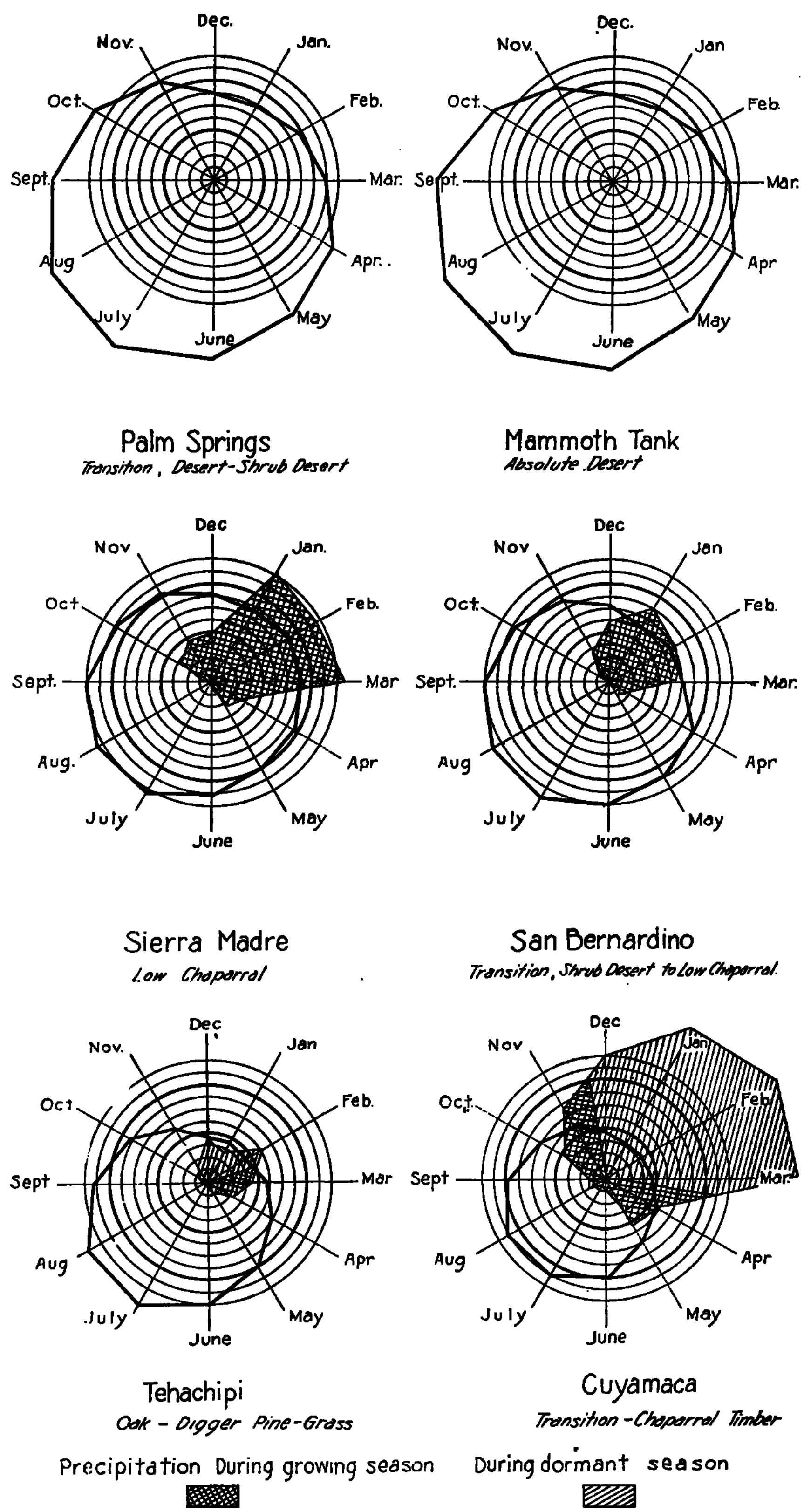

Fig. 2 Climatographs for Southern California

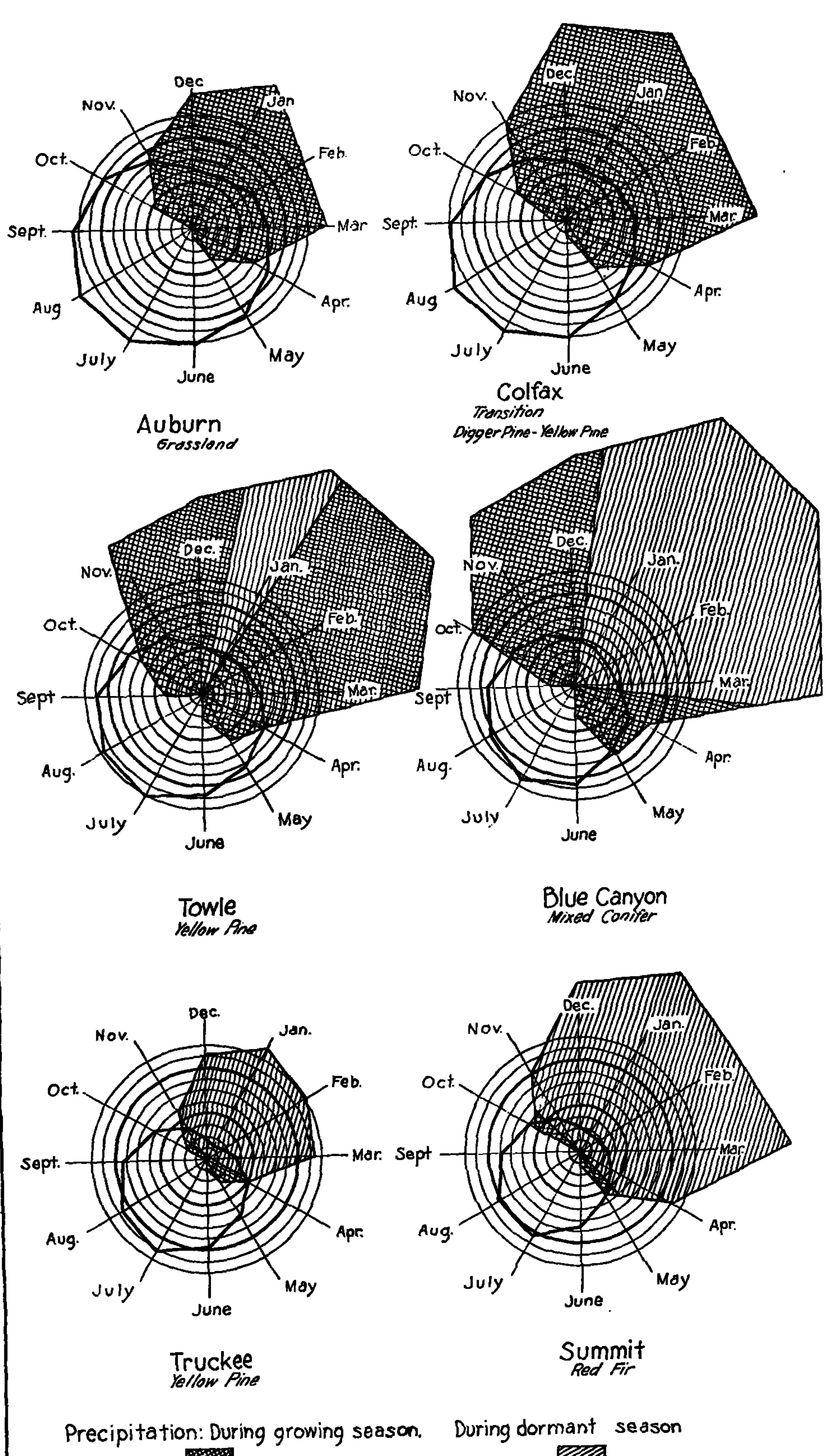

Fig. 3 Climatographs for Central California

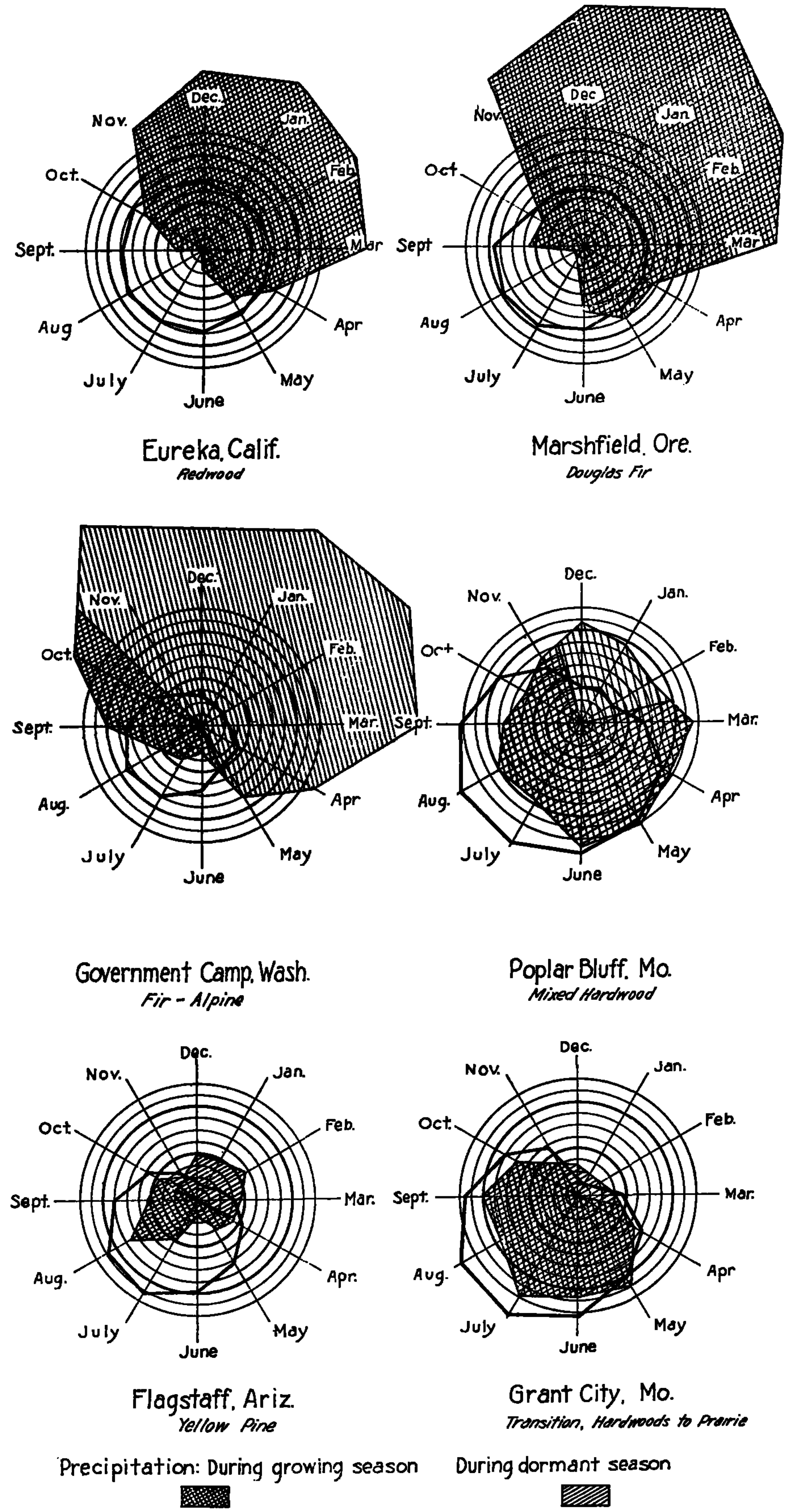

Fig. 4 Climatograph of Selected Western Stations

Thus in studying the two charts—one of temperature and one of precipitation—we see at once that the bulk of the precipitation occurs during the growing season. The distribution during this season is relatively uniform from month to month. There is sufficient late winter precipitation to form a surplus available when growth begins in the spring. There is probably snowfall to cover the soil, thereby ameliorating the soil temperature to some extent. From the second chart it is evident that the growing season lasts about six months during which the average temperature is about 55° or 60°, while the winters are severe, especially during December and January. There is a small spread in the range of annual temperature, and the mean annual temperature—roughly the center of the polygon—is about 42°.

To have two figures to deal with is rather awkward and entails considerable work, so that it has proved both feasible and practicable to unite them, as shown in Figures 2, 3, and 4, by superimposing the temperature polgyon upon that of precipitation. In order to keep these separate, the precipitation occurring during the growing season is cross hatched in order to differentiate it. It then becomes easy to separate the desired factors in the comparison of any two climates.

Figure 2 shows these climatographs for a few stations in southern California and indicates the uses which can be made of them. By a little study of many such figures as shown in Figure 3, it is possible to see the gradations between stations; how the temperature chart contracts, the precipitation chart increases, the development of the growing season, the distribution of the precipitation. With the correlation of the native vegetation with each climate, one can soon select the essential characteristics of the different localities and some of the limiting factors controlling distribution.

In compiling these data, it has been found that the ordinary 3 by 5 library card offers the best opportunity of comparing stations. The charts usually fit nicely upon these, except some stations where the winter precipitation is tremendous, and in such cases the amounts can be written upon the radii. The use of two colors brings out the precipitation and temperature data better than the one color, and obviates the necessity for so much crosshatching. Much more data can be put on these charts, making the division one of 10-day periods instead of months and, instead of mean temperatures, it is possible to use the mean maximum and mean minimum temperatures. The back of the cards offers an opportunity to make such notations as are desired, or to enumerate particular features about the station, such as its location, elevation, character of crops grown, prominent vegetation, proximity of bodies of water, and other similar information.

The use of this form of chart is not confined to the representation of temperature or precipitation alone, as it has been used also with humidity, pressure, evaporation, and other phenomena that one might desire to compare on a monthly basis.

THE USE OF CHARTS AND GRAPHS IN THE STUDY OF CLIMATE.[1]

By VERNA B. FLANDERS.

[Clark University, Worcester, Mass., August, 1922.]

When I first studied types of climate, I did so by steadfastly gazing at columns of figures for a given station and then reading a meager description in the text. No thought of comparison or contrast with my own environment occurred to me, few human responses to climate were suggested, and, altogether, no very definite mental picture of the different types remained with me. Perhaps this was just as well, since I was later to approach the subject from a much more interesting angle.

One of the greatest helps toward visualizing and understanding climatic data is the use of graphs and charts. I have chosen a number of contrasting types of climate from our own country and shall try to show how much information can be gained from two types of representation—the climatic chart (Goode) and climograph. A hasty glance at the accompanying diagrams reveals much of value, but the student will find added help if he will actually construct the charts himself and will experiment with graphs he finds most helpful. The knowledge needed, the care required, the interest in seeing how "it" is coming out, and finally the interpretation of the product—all lead to a new and absorbing interest in the subject.

On the climatic charts[2] is shown the following data for each station in so far as figures could be found: (1) Location, (2) elevation, (3) sunshine record, (4) wind-direction record, (5) average monthly relative humidity (8 a.m. and 12 m. readings average), (6) average monthly rainfall and total for year, (7) average monthl ytemperatures and yearly averages. These figures are entered in full on the back of each chart with additional data such as (1) average monthly and yearly vapor pressure (8 a. m. and 8 p. m. readings averaged), (2) average monthly wind velocity and yearly average.

It is of interest just here to note that all this information can be obtained from two publications of the United States Weather Bureau—Bulletin W and MONTHLY WEATHER. REVIEW SUPPLEMENT 6. They are available in some of our larger schools and libraries.

The chart for New York (fig. 1) shows the city's moderate, evenly distributed rainfall, the fairly large range of temperature, moderately high relative humidity, and the delayed maximum and minimum temperatures—all evidences of our littoral type of climate in middle latitudes. Such questions as—Why has February such a low temperature? Why is the relative humidity highest in winter? Why do prevailing winds in June and July come from the southwest? Account for the evenness of the rainfall distribution—stimulate thought and investigation and direct the pupil's study of the charts.

Savannah exhibits in its summer rainfall an almost monsoon tendency. How can we account for the considerable rainfall in winter? Why has it a smaller range of temperature than New York? Why has it a greater range of temperature than Los Angeles?

Continental influences show in St. Louis's chart (fig. 1) in the increased range of temperature and the early summer maximum of rainfall. Williston is more markedly continental in a higher latitude.

[1] Thesis submitted in course on climatic environments, Clark Summer School, Worcester, Mass., August, 1922.

[2] The charts here referred to are drawn on the well-known Goode base climatic chart No. 80. Lack of space prevents the reproduction of all of them, but we have combined the essential features of four of them so as to give a cross section of the United States about latitude 40 N. and present it in fig. 1. The climographs appear in fig. 2.—ED.